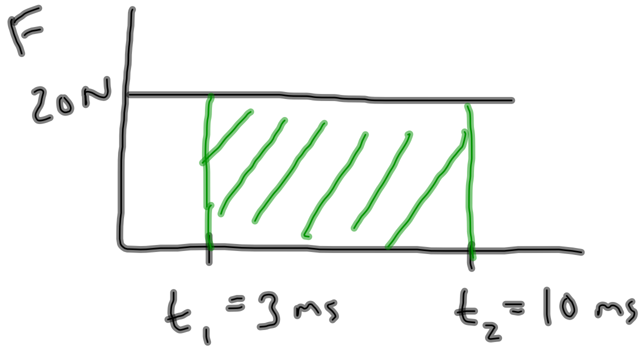
Collision Notes and Practice Problems 10.5.11 AP Physics

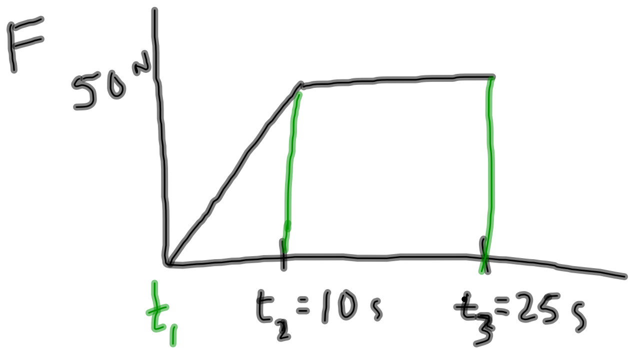


$\bar{J}$ = area under curve

$= F\Delta t$

$= (20\,N)(10\,ms - 7\,ms)$

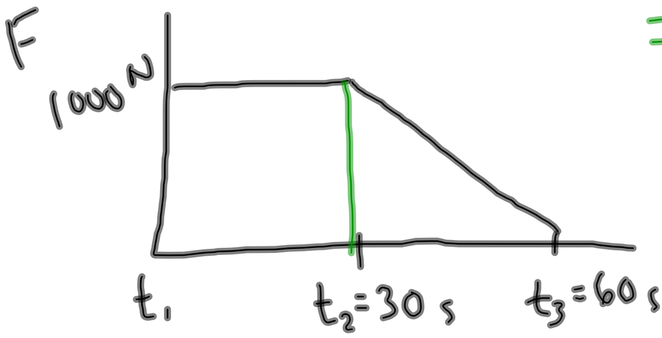
$= .14\ kg\cdot m/s$



$\bar{J} = \frac{1}{2}F(t_2 - t_1)$

$+ F(t_3 - t_2)$

$= 1000\ kg\cdot m/s$



$\bar{J} = 45\,000\ kg\cdot m/s$

HW:

p. 261: 7, 8, 9, 15

Test Tuesday, 10/11

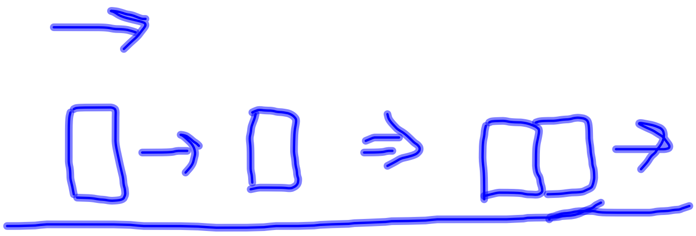
Collisions Notes:

- Use cons. of momentum always
- Two types:
  - Perfectly elastic → energy is also conserved
  - Perfectly inelastic → Energy NOT conserved
- Choose +/− directions
- Rotate axis to make life easier
- Equations:
  - Elastic: $m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$
  - Inelastic:

$$(m_1+m_2)\bar{v}_i = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = (m_1+m_2)\bar{v}_f$$

An 1800 kg car stopped at a traffic light is struck from the rear by a 900 kg car. The two cars become entangled, moving along the same path as that of the originally moving car. If the smaller car were moving at 20.0 m/s before the collision, what is the velocity of the entangled cars after the collision?



$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = (m_1 + m_2)\bar{v}_f \qquad (m_2\bar{v}_{2i} = 0)$$

$$\bar{v}_f = \frac{m_1\bar{v}_{1i}}{m_1 + m_2} = \frac{(900\ \text{kg})(20.0\ \text{m/s})}{(900\ \text{kg} + 1800\ \text{kg})}$$

$$= 6.67\ \text{m/s}$$

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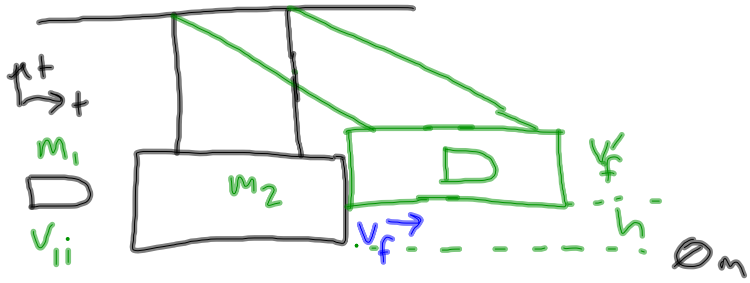
The ballistic pendulum is an apparatus used to measure the speed of a fast-moving projectile such as a bullet. A projectile of mass m_1 is fired into a large block of wood of mass m_2 suspended from some light wires. The projectile embeds in the block, and the entire system swings through a height h. How can we determine the speed of the projectile from a measurement of h?



- 2 part problem:
  - bullet/block → cons. of $\bar{p}$
  - swing of combined b/b → cons. of E

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = (m_1+m_2)\bar{v}_f \qquad (m_2 v_{2i} \to 0)$$

$$v_f = \frac{m_1 v_{1i}}{m_1+m_2}$$

$v_f = v_i$

$$K_i + U_{gi} = K_f + U_{gf} \qquad (U_{gi} \to 0,\ K_f \to 0)$$

$$\frac{1}{2} m v_i^2 = m g h_f$$

$$\frac{1}{2}(m_1+m_2)v_f^2 = (m_1+m_2) g h$$

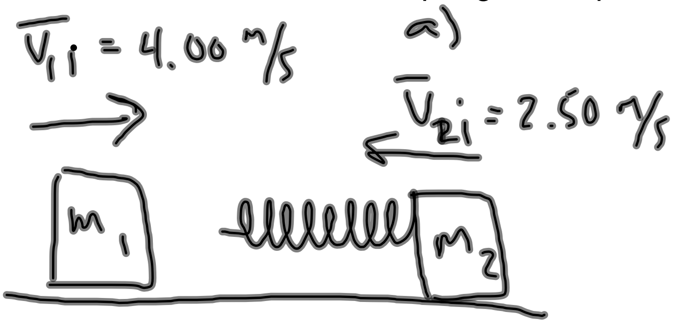
$$\frac{1}{2} v_f^2 = gh$$

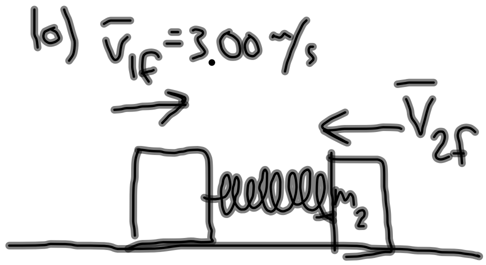
$$v_f = \sqrt{2gh}$$

$$\frac{m_1 v_{1i}}{m_1+m_2} = \sqrt{2gh}$$

$$v_{1i} = \left(\frac{m_1+m_2}{m_1}\right)\sqrt{2gh}$$

A block of mass 1.60 kg initial moving to the right with a speed of 4.00 m/s on a frictionless, horizontal track collides with a spring attached to a second block of mass 2.10 kg initial moving to the left with a speed of 2.50 m/s. The spring constant is 600 N/m.
a) Find the velocities of the two blocks after the collision.
b) During the collision, at the instant block 1 is moving to the right with a velocity of + 3.00 m/s, determine the velocity of block 2.
c) Determine the distance the spring is compressed at that instant.





a)

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

$$\frac{1}{2}m_1v_{1i}^2 + \frac{1}{2}m_2v_{2i}^2 = \frac{1}{2}m_1v_{1f}^2 + \frac{1}{2}m_2v_{2f}^2$$